Active Project (2014 - 2016)

CubeSat High Impulse Propulsion System (CHIPS), Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

CU Aerospace proposes to perform design, fabrication, and ground test validation of a nanosat primary propulsion subsystem using non-toxic R134a propellant. Our approach, called CubeSat High Impulse Propulsion System (CHIPS), leverages CU Aerospace's very high efficiency warm-gas variant of an innovative resistojet that significantly boosts the performance of standard cold-gas systems with the existing Micro Propulsion System (MiPS) thruster technology development by our team partner, VACCO Industries. The MiPS system has been tested to 200,000 cycles without any technical issues, demonstrating excellent reliability. A 1.5U CHIPS subsystem, using non-toxic R134a propellant, is a compact thruster system having a total impulse of 680 N-s and a fully throttleable continuous thrust of 30 mN. The subsystem also includes an R134a 3-axis cold-gas attitude control system to replace reaction wheels. Approximately 25 W of primary power is required from a lithium-ion battery included in the 1.5U package. This low-cost subsystem demonstration will pioneer a family of nanosat propulsion systems, which will become available to the CubeSat and nanosatellite communities for orbit change, de-orbit, precision maneuvering, and drag makeup missions.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: CHIPS technology supports the NASA Roadmap for In-Space Propulsion Systems, nonchemical propulsion. CubeSats and nanosatellites with CHIPS would enable a number of different significant missions for low Earth orbits including orbit raising, orbit phasing, and deorbiting. The drag makeup capability of CHIPS would allow low altitude endo-atmospheric orbits, permitting onboard sensors to operate at lower altitude. Using a cold-gas mode, CHIPS also has the capability for precision position adjustments,

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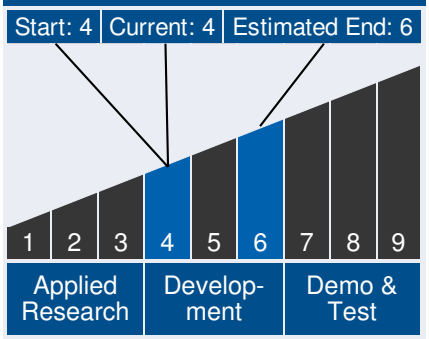
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

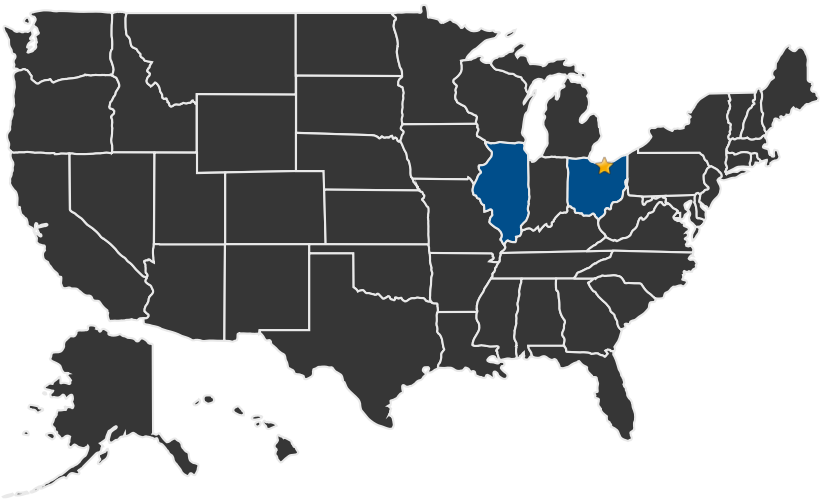
Continued on following page.

enabling missions requiring station keeping, formation flying, and docking. CHIPS would improve mission affordability for multiple CubeSats, since several CubeSats with CHIPS could be launched from a single low-cost booster and maneuvered to other orbits, then later deorbited. Note that CHIPS is easily scalable to smaller or larger sizes (total impulses), depending on mission and payload requirements, by changing the tank volume. Battery size can either be scaled, or kept the same size if recharging between thrust events is practical for the mission.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The CHIPS thruster family provides a compact, non-hazardous, dual-use propulsion technology solution with projected low cost, that will be made available in sizes that can meet the differing needs of users in NASA, DOD, industry, and academia for CubeSat and nanosatellite missions.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Management Team *(cont.)*

Project Manager:
- Heather Hickman

Principal Investigator:
- David Carroll

Technology Areas

Primary Technology Area:
In-Space Propulsion Technologies (TA 2)
└ Chemical Propulsion (TA 2.1)
  └ Cold Gas/Warm Gas (TA 2.1.6)
    └ Cold Gas/Warm Gas (TA 2.1.6.1)

Secondary Technology Area:
In-Space Propulsion Technologies (TA 2)
└ Non-Chemical Propulsion (TA 2.2)

Additional Technology Areas:
In-Space Propulsion Technologies (TA 2)
└ Non-Chemical Propulsion (TA 2.2)
  └ Electric Propulsion (TA 2.2.1)
    └ Resistojets (TA 2.2.1.9)

Other Organizations Performing Work:

- CU Aerospace, LLC (Champaign, IL)

PROJECT LIBRARY

Additional Images

- Briefing Chart Image
  - (This image is a .tif file. Please visit http://techport.nasa.gov:80/file/21909 to download this image to view it.)

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23040)

DETAILS FOR TECHNOLOGY 1

Technology Title

CubeSat High Impulse Propulsion System (CHIPS)

Potential Applications

CHIPS technology supports the NASA Roadmap for In-Space Propulsion Systems, nonchemical propulsion. CubeSats and nanosatellites with CHIPS would enable a number of different significant missions for low Earth orbits including orbit raising, orbit phasing, and deorbiting. The drag makeup capability of CHIPS would allow low altitude endo-atmospheric orbits, permitting onboard sensors to operate at lower altitude. Using a cold-gas mode, CHIPS also has the capability for precision position adjustments, enabling missions requiring station keeping, formation flying, and docking. CHIPS would improve mission affordability for multiple CubeSats, since several CubeSats with CHIPS could be launched from a single low-cost booster and maneuvered to other orbits, then later deorbited. Note that CHIPS is easily scalable to smaller or larger sizes (total impulses), depending on mission and payload requirements, by changing the tank volume. Battery size can either be scaled, or kept the same size if recharging between thrust events is practical for the mission.